The information processing models share an orientation toward the information processing capability of students and ways they can improve their ability to master information. Information processing refers to ways people handle stimuli, organize data, sense problems, generate concepts and solutions to problems and employ verbal and nonverbal symbols. Some information processing models are concerned with the ability of the learner to solve problems and thus emphasize productive thinking, others are concerned with general intellectual ability. A large number emphasize concepts and information derived from the academic discipline. While all attempts to help students grow influence their information processing, many methods and theories are designed specifically to help students acquire and operate on data. To many people, conveying information is the primary business of the school, and this widespread interest in information processing models is certainly one reason for having so many models in this category.

Each model has a distinct point of view about how people think and how to affect the ways they operate on information. It should not be assumed that all of these models are built on mechanistic theories about the human mind; on the contrary, some of them have rather unstructured views of information handling. They vary too in the breadth of their approach. Some focus on narrow aspects of information processing (e.g., how to memorize) or on specific types of inductive thinking. Others are designed to influence basic thought patterns.

Thus range of information processing models is considerable, and they offer the teacher several views of how students think and a good variety of teaching was for trying to improve thinking ability. Various models under information processing models are Con-
cept Attainment which includes specific method of teaching concepts with precision, as it explores the nature of thinking. The inductive thinking and inquiry training are designed to teach students how to develop concepts and how to inquire and theorize. Advance Organizer model designed to teach systems of information and ideas. Another model enhances memorization is (Memory Model). A model developed from Piaget's work- aims to increase the rate of mental development (cognitive growth). Lastly Scientific Inquiry model designed to teach the research system of a discipline.

The models of teaching chosen for the present study belongs to the information processing family. The focus is on the Concept Attainment model, Inductive Thinking model and Advance Organiser model.

2.1. Concept Attainment Model:

The Concept Attainment Model was developed from the work of Jerome Bruner, Jacqueline Goodnow and George Austin. It is used for teaching students of all ages to learn concepts and practice analytical thinking skills. The concept are learnt through concrete examples and non examples. For example there is an array of fruits in front of children, a variety of apples but one or two oranges and pears. If our concept is 'apple' then pears and oranges are negative examples. The Concept Attainment Model tries to develop thinking skills in the students and help the students to develop and form new concepts.

2.1.1. Goals and Assumptions

Every human being is engaged in the process of categorizing with which we classify different objects depending upon their characteristics, categorizing help us to reduce the necessity for constant new learning. As long as an object or event display the defining characteristics of a class we do not have to learn at each encounter. Thus categorizing helps us to reduce the complexity of a problem.
2.1.2 Theory of concepts

Bruner views any concept in having five elements:

1. Name- The name is the term given to a category, we group all the things in a single category and give it a particular name.

2. Examples- These are instances of the concept. Some are positive examples and some are negative examples. Both type of example can be described in terms of its attributes and attribute values.

3. Attributes- Each example can be described in terms of its basic characteristics. These basic characteristics are called attributes.

4. Attribute Value- It is a specific content of that category.

5. Rule- It is the definition or statement specifying the essential attribute of a concept.

Understanding a concept means knowing all the elements of the concept.

2.1.3 Types of Concepts- Bruner identified following three types of concepts:

1. Conjunctive- These concepts are defined by the presence of several attributes.

2. Disjunctive- These concepts require the presence of some attributes and absence of others.

3. Relational- These concepts like conjunctive concepts have several attributes, but these bear some kind of relationship to one another.

2.1.4 Structure of the Model:

The model has two cyclical phases which are followed by closure and application.

Phase - I: Presentation of examples.

In this phase teacher explains how the activity would proceed and then he says that he has some concept in mind and he displays to the students with examples and nonexamples of the concepts. He can give more examples if need arises.
**Phase II: Analysis of Hypothesis**

This phase begins when students formulate a hypothesis or think in terms of attributes of the concept as a name for the concept by comparing and contrasting examples and nonexamples.

Phase I and Phase II are cyclical because one can go back to phase I and again shift to phase II. For example, when a teacher notices that students have formulated a false or wrong hypothesis or hypotheses are unclear and vague, he goes to phase I and gives more examples and nonexamples of the concept. At this point, students again return to phase II determining that which hypotheses are acceptable and which one are to be rejected based on examples. They may suggest new hypothesis. The process of presenting additional examples and continuing to analyse hypotheses continued until all the hypothesis but one were eliminated.

**Phase III: Closure**

When the analysis process has eliminated all but one of the hypotheses, the students are then asked to define explicitly and identify the attributes.

**Phase IV: Application**

In the final phase, the students apply the concept by giving examples and nonexamples of concepts and secondly by classifying examples.

**2.1.5. Elements of Concept Attainment Model**

1. **Focus** - the educational objectives of Concept Attainment Model are
   a) Content goals- (i) To acquire new concepts.
      (ii) To enrich and clarify known concepts.
   b) Thinking skills goals- (i) To develop and awareness of thinking strategies.
      (ii) To understand the nature of conceptual activity.
      (iii) To develop hypothesizing and analyzing.
2. Syntax: There are two types of strategies in concept attainment model such as

(A) Reception Strategy (B) Selection Strategy

(A) Syntax of the Reception Model

Phase I - Presentation of data and Identification of Concept
- Teacher presents labelled examples;
- Students compare the attributes;
- Students generate and test hypothesis;
- Students name the concept;
- Students state a definition

Phase II - Testing Attainment of the Concept
- Identifying additional unlabelled examples
- The pupils generate examples

Phase III - Analysis of Thinking Strategies
- Discuss thoughts
- Discuss the role of hypothesis
- Discuss the type and number of hypothesis;
- Evaluate Strategies

(B) Syntax of Selection Model of Concept Attainment

Phase I - Presentation of data and Identification of Concepts
- Teacher presents unlabelled examples;
- Students inquire which example including their own are positive ones;
- Students generate and test hypothesis.

Phase II - Testing Attainment of the Concept
- Students identify additional unlabelled examples;
- Students generate examples
Teacher confirms hypothesis and names concept and restates definition according to essential attributes.

**Phase III- Analysis of Thinking Strategies**

- Students describe thought;
- Students discuss role of hypothesis and attributes;
- Students discuss type and number of hypotheses.

**C. Syntax of Unorganized Material Model**

**Phase I-**
- Description of concept as it is used;
- Locate the concept and identify attributes being used.

**Phase II-**
- Discuss adequacy and appropriateness of concept being used;
- Compare examples to other data using some concept.

**3. Principle of Reaction:**

During the process of teaching the teacher should encourage the student and he should be supportive at every step. The interaction between the teacher and the students should be a natural one. He should see that neither the students nor himself stacks in any situation.

**4. Social System**

Prior to teaching with concept Attainment Model the teacher choose the Concept, selects and organizes the material into positive and negative examples. The teacher should give reasonable freedom to the student for discussion with each other. There should be proper interaction of the learner with the teacher concerned. The three major functions of the teacher during the concept attainment activity are record, prompt and present additional data.
5. Support System

Concept attainment lessons require material that has been designed so the concepts are embedded in the material with positive and negative examples. When students are presented with an example they describe its characteristics which can be recorded on the blackboard. The use of blackboard or flash cards displayed on Flannel Board would become a support for the success of the model.

2.1.6 Planning Concept Attainment Activities

1. Identifying Goals

a. Content goals: At this stage teacher decide about the specific objectives of the content to be presented. The instructional objectives are formulated keeping in view the age, class course of study and taxonomic category of the objectives. The teacher decides whether his purpose is that the students are able to define the concepts, understand and apply it to new situation. In short, deciding on exactly what you want the students to know about the concept.

b. Thinking skill goals: The thinking skills students employ in a concept Attainment Model are more demanding than used in inductive or other models of teaching concepts. In this model students are required not only to observe and describe examples but also they are asked to hypothesize a lab for the concept. Students may follow scanning or focussing or sometimes both while analysing examples and formulating hypothesis or naming the concept.

2. Selecting examples-

The guiding principle in selecting examples is identifying those that best illustrate the characteristics of the concept.

3. Sequencing examples-

Having selected examples and nonexamples the final step in planning is to place
them in a sequence designed to most effectively promote practice in thinking skills. So examples are arranged in a logical and chronological order.

2.1.7 Implication:

The Concept Attainment Model may be used with all ages and grade levels. It is an excellent evaluation tool for the teacher to determine whether important ideas introduced earlier have been mastered. It quickly reveals the depth of student understanding and reinforces previous knowledge. It also provides practice in inductive reasoning and improves concept building strategies of the students. (Based upon this model a specimen lesson plan is appended as Appendix I.

2.2 INDUCTIVE THINKING MODEL

Educational writers, philosophers and social reformers and educators have tried the number of ways for improving power of humans to process information and solve problems. Thus there are many models for teaching thinking. Hilda Taba has developed a series of teaching strategies designed to develop inductive mental processes especially the ability to categorize and to use categories. She is mainly responsible for popularizing the term teaching strategy and her work in the Centra Costa school District provide a first rate example of a teaching strategy designed to improve the students ability to handle information. Thus the Inductive Thinking Model is designed to instruct the students in concept formation and simultaneously to teach concepts. It nurtures attention to logic, to language, the meaning of words and to the nature of knowledge. There are three postulates of thinking -

(i) Thinking can be taught
2.2.1. Three teaching strategies:

To implement the inductive thinking model three thinking inductive task can be used which are as follows-

1. **Concept formation**: This stage involves-
   (i) Identifying and Enumerating the data that are relevant to the problem.
   (ii) Grouping those items according to some basis of similarity.
   (iii) Developing categories and labels for the groups.

   She invented that teaching moves in the form of question, for example the question "What did you see?" might induce the students to enumerate a list. The question "what would we call these groups?" would likely induce people to develop labels of categories.

   The purpose of this strategy is to induce students to expand the conceptual system with which they process information. In the first phase they are required to group the data, an activity requiring them to alter and expand their capacity for handling information, in other words they have also to form concept which they subsequently, can use to approach new information they encounter.

2. **Interpretation of Data**:

   This strategy is built around the mental operations. She refers to as interpreting, inferring and generalizing. The interpretation of data strategy is propelled by the Teacher's eliciting question. In the first phase the teacher's question lead students to identify certain aspects of selected data. For example after students have completed reading about the economic systems of the union of South Africa, Great Britain and Germany the teacher might ask, "What are the important aspects of the economic systems of these three countries?"
Second, the students are to explain items of identified information relating the point to each other. Here the teacher asks questions concerning causes and effects. For example, he may simply ask, "Do you think the economic systems of the three countries are very similar or different? Why?". In the third phase, inferences are made in which no one gives the "correct" answer; it gives rise to conjecture and inferences that would require the student to go beyond the given data and to arrive at some conclusions. Based on inferences about them.
2.2.2 Application of Principles.

This is the third cognitive look around which Taba builds a teaching strategy and applies principles to explain new phenomena. The students would be required to expand their capacity to handle information first by developing new concepts and then developing new ways of applying established principles in new situations.

The first phase of the strategy requires students to predict consequences, explain unfamiliar data or hypothesize. For example, he may ask students, how would it change the picture of the value of currency, which were based on iron ore?

In second phase students attempt to explain or support the prediction. For example- if some one feels that a fixed currency rate for all countries should be established and hold for a long time he would attempt to explain why he thought this system would work.

In third phase students verify these predictions or identify conditions that would verify the predictions.

2.2.3 Elements of the Model

The fundamental elements of inductive thinking model are:-

(1) Focus:- The main instructional objectives of the model are to develop skill of concept formation process.

(2) Syntax:- In inductive thinking model the three teaching strategies strongly resemble each other. Each is built around a mental operation. Concept formation, interpretation of data, application of principles or idea. In each case the strategy involves overt activities, that assume students must go through certain covert operation to perform the activities forms the syntax of teaching strategies and is presumably accompanied by un-
derlying mental processes in each case the teacher moves the strategy along by mean of eliciting questions to guide the students from one phase of activity into the next at the appropriate time. But too delay or too long lose opportunities and interest.

**Strategy-I**  **Concept Formation** - It has three phases -
- Enumerating or testing of data
- Grouping of data
- Labelling and categorizing

**Strategy-II**  **Interpretation of data** - Its phases are -
- Identification of relationship in the date
- Explaining the relationship
- Drawing inferences

**Strategy-III**  **Application of Principles** - It phases are -
- Developing new concepts.
- Establishing concepts into new situation.
- Verify the prediction.

(3) Social System -
In all these strategies the atmosphere of the classroom is cooperative with a good deal of pupil activity. The teacher is initiator of phases and all the activities are determined in advance. However as the students learn the strategies they assume greater control.
(4) Principles of reaction:

In this model teacher tries to match question to student’s level of cognitive ability. The teacher must be sure that the cognitive task occur in optimum order and also occur at the right time. The teacher’s primary mental task in the course of the strategies is to monitor how students are processing information and then to use appropriate eliciting questions. As students became more sharp and master the thinking strategy the teacher changes the level of questions and the teacher determine students’s readiness for new experiences and new cognitive styles.

(5) Support System:

Student need raw data to organise analyse, hypothesize, predict and draw inferences. Teacher’s Job is to help them process the data in increasing complex ways and at the same time to increase the general capacity of their system of processing data.

(6) Application:

The primary application of the model is to develop thinking capacity. It also helps in increasing productive and creative thinking. Inductive process includes the creative processing of information as well as the convergent use of information to solve problems. It is a strategy especially suited to philosophies of education and instruction that call for active learning and require manipulative materials.

2.2.4. Implication:

In actual teaching situation the Tabas’s teaching strategies are built on particular mental or cognitive task. It is very important in developing thinking capacity of the students. Inductive Thinking Model can be used in various subjects like English, Science, Economics etc. In this model we go beyond the given topics, which helps in increasing productive and creative thinking. In this way both the processes of Taba and Bruner can
be used (concept formation and concept attainment). Based upon their model a specimen lesson plan is appended as appendix II.

2.3. Advance organizer Model:

An important resource in the classroom is written material. A perennial concern of educators is the preparation and use of material that are organized in such a way as to maximize learning. David Ausubel (1970) is the originator of this model. He is unusual among educational theorists. He stands in contrast with those who advocate discovery methods of teaching, open education and experience based learning. David Ausubel is one of the few educational psychologists to address himself simultaneously to learning teaching and curriculum. Ausubel, in his theory of meaningful verbal learning advocate the use of advance organizers to facilitate the learning of written materials. According to Ausubel's theory of meaningful verbal learning, advance organizers are introduced in advance of new learning tasks and are formulated so that they take into account ideas and concepts already existing in the cognitive structure of the learner. His theory of meaningful verbal learning deals with three concerns.

(a) how the mind works to process new information? (learning)
(b) how teachers can apply these ideas about curriculum and learning when they present new material to students (instructions) and
(c) how knowledge is organized? (curriculum content)

Advance organizer model deductively aim at developing and increasing the information processing mental capacities of the learner.

Joyee and Showers (1985) have applied themselves to the important problem of how teachers can effectively learn new and alternative teaching, strategies, "natural" teaching style of the teachers are relevant to the acquisition of new model.
and how does personality effects the acquisition of particular models learn higher conceptual level of teachers acquired models of teaching more easily than low conceptual level teachers. Joyce and Weil reported that However, no other aspects of the individual personalities were studied that too related to Advance Organizer Model.

Mayer's reported that advance organizer generally have few characteristics, which are as follows:-

(1) Short set of verbal or visual information;
(2) Presented prior to learning a large body of information to be learnt;
(3) Containing no specific content from the information to be learnt;
(4) Providing a means of generating logical relationships among elements, in the to be learnt information;
(5) Influencing the learners encoding process.

Ausubel (1977), Barner and Clawson (1975); Hartley and Davis (1976) and Mayor (1978) revealed that advance organizers have secondary functions in addition to providing ideational Scaffolding or a meaningful context for new learning material. An advance organizer provides an overview of the more detailed information to follow and may influence the learning set by increasing student motivation and or encouraging use of active encoding strategies on the part of the learner.

2.3.1 Types of Advance organizer Model :-

Ausubel gave two types of advance organizers depending upon the learner's degree of familiarity with the material which is as follows:-
(1) **Expository Advance Organizer:** It provides general model of class relationship as a general subsumes for a new class, species and special before more limited subsumes are provided for the particular subclass or species. These are used when the material to be learnt is complete.

(2) **Comparative Advance Organizer:** It is used most with relatively familiar material. It is designed to integrate new concepts with, basically similar concepts existing the cognitive structure, yet it is also designed to discriminate between the old and new concepts in order to prevent confusion caused by its similarity.

Many theorists have explained how learning occurs but don’t help us to teach and organize a curriculum. The advance organizer Model of teaching provides recommendations to teacher for selecting, ordering and presenting new information. This model does not expect the learner to have to do any thing with the material expect to internalize it.

### 2.3.2 Objectives of Advance Organizer Model:

The objective of Advance Organizer Model are as follows:

1. To help teacher convey large amount of information as meaningful and efficiently as possible;
2. To help students acquire subject matter;
3. To strengthen student’s cognitive structure.

By cognitive structure, Ausubel means a person’s knowledge of a particular subject matter at any given time and how well organized clear and stable it is. Before we can present new material effectively. We must increase the stability and clarity of our students. Prior knowledge strengthening students’ cognitive structure in this way facilitates their acquisition and relation of new information.
2.3.3 Elements of the Model.

The advance organizer model is described into different steps or it has the following elements:

(1) Syntax: The Advance Organizer Model of teaching consists of three phases:

**Phase-I Presentation of Advance Organisers**

In this phase, first of all, objectives are explained and classified, and after that the advance organizer is presented and examples are given.

**Phase-II Presentation of learning material**

In this phase, the learning material is presented. This is presented through lecturers, films, scripts, discussion, experiences, extra reading material etc. The learning is organised in logical order. Attempts are made to maintain interest.

**Phase-III Strengthening Cognitive Organisation**

This phase tests the relationship of the learning materials to existing ideas to bring about an active learning process. The purpose of this phase is to anchor the new learning material in the student's existing cognitive structure. There are several ways to facilitate reconciliation of the new material with the existing cognitive structure such as teacher can:-
i) remind students of the ideas.
ii) ask for a summary of the major attribute of the new learning material;
iii) repeat precise definition;
iv) ask for difference between aspects of the material;
v) ask the students to describe how the learning material supports the concepts or proposition that is being used as a subsumer.

2. Social System

The teacher controls all the intellectual structure. It is necessary continually to relate the learning material to the organizers and to help students differentiate new materials from previously learnt material. In phase three, however the learning situation is ideally much more interactive, with students initiating many questions and comments. The successful acquisition of the material will depend on the learner’s desire to integrate it with prior knowledge on their critical faculty and on the learner’s presentation and organisation of the material.

3. Principles of Reaction

The teacher’s solicited or unsolicited responses to the learner’s reaction are to be guided for the purpose of clarifying the meaning of new learning material, differentiating it from and reconciling it with existing knowledge, making it personally to promote a critical approach to knowledge.

4. Support System

Well organised material is the critical support requirement of this model. The effectiveness of the advance organiser depends on an integral and appropriate relationship between the conceptual organiser and the content.

5. Application

i) The advance organizer model is especially useful to structure extended
curriculum sequences or courses and to instruct students systematically in
the key ideas of a field

ii) This model can also be shaped to teach the skills of effective reception learning.

iii) It increases the learner's grasp of factual information linked to and explained
by the key ideas.

iv) Whenever ideas or information needs to be presented, renewed or clarified
the advance organiser is useful model.

2.3.4. Implications-

In the actual teaching situation the primary way of strengthening cognitive struc-
ture and enhancing relation of new information is through the use of Advance Organizer.
The most effective organizers are those that use concepts, terms and propositions that
are already familiar to the learner as well as appropriate illustrations and analogies, Ad-
vance Organizers are generally based upon the major concepts proposition generaliza-
tions, principles and laws of a discipline

Thus Advance Organizer Model after introducing new material is a deductive, pre-
sentational way, can be followed by inductive concept attainment activities that reinforces
the material or that informally evaluates students acquisition of the material. (based upon
this model a specimen lesson plan is appended as Appendix ii)

It has been concluded that teaching with these three models i.e Concept Attain-
ment Model, Advance Organizer Model, Inductive Thinking Model is to be carried out in a
small groups in a planned and systematic manner. So, before the investigator will teach in
small groups of the students it will be necessary to first identify and understand the re-
search that has already been done in the field of interest. It is
therefore essential for a researcher to have a thorough and systematic review of the research literature in her area of interest.

2.4 Review of Related Literature:

The review of related literature involves locating, reading and evaluating reports of research as well as reports of casual observation and opinion that are related to the individual's planned research project. A review of related studies is crucial aspect in the planning of a new study. It helps to eliminate the duplication of what has been done and provides useful hypothesis and helpful suggestions for significant investigation. Although the search for related studies is time consuming. Yet it proves to be fruitful phase. It act as a light house to discover what is already known, what are the pitfalls of the previous studies and also widens our outlook, knowledge, insight and experience with regard to the subject. It helps us to know what others have tried to find out, what methods of attack have tried to find out, what methods of attack have been used successfully and what problems remain to be solved.

Here is the description of few studies which have been conducted on models of teaching:

2.4.1 Reviews on Concept Attainment Model:

Byers (1961) experimented his study to know the relationship of strategies in efficiency of performance having a sample of 30 men and 30 women randomly selected from educational psychology classes at the University of Wisconsin and utilized a random replicated 6x6 latin square design. He found that strategies influenced efficiency of performance. The most efficient performance was associated with the low risk strategies, conservative focussing while the least efficient performance was associated with high risk strategies focus gambling.
Lemke (1965) identified the relationships between concept attainment and information processing tasks. Sample consisted of 9 females from two classes in educational psychology during the second semester 1963-64 at the University of Wisconsin. A battery of sixteen tests, Incomplete Image Analysis and Alpha factor Analysis were used. He found that the span and the rote memory factors representing the memory domain, were isolated and found to clearly unrelated to the task factors. The results generally supported studies using similar stimulus materials and presentation modes. The factor of the reasoning domain were all related in degree to the task factors, however. Deduction and Spatial Scanning, factors thought to be related the domain, were only marginally related to the concept attainment and information processing factors. The verbal comprehension factor was found to be related to the task factors which suggests that inclusion of additional factors from 1 to domain might account for additional variance in the study of abilities and their relationship to concept attainment & information processing.

Meinke (1966) investigated the effects of several methodological variables upon the efficiency of attaining concepts. The finding showed that there were significant main effects for the three independent variables when using anyone of the three dependent variables as the measure and there were significant second and third order interaction.

Carol (1968) investigated the effects of concrete and formal cognitive behaviour and methods of instructional feedback (minimum and maximum on the generalization of concept attaining over varying intervals of time (0, 10, 20 days) between the initial learning and test task. He found that there was a significant relationship between cognitive level and performance, the formal group performed more efficiency than the concrete group. There was no other statistically significant result. However date trend indicates that (i) Minimum feed back was more effective in facilitating performance for the formal group than for Concrete group.
Maximum feedback for Concrete group resulted in more efficient performance than minimum feedback.

Tamppari (1969) specified biological concepts related to an important theme which was taught in existing biological curriculum in order to identify concept according to learning theory of Robert M. Gagne and studied the attainment of the identified concepts by students in grade five, seven, and nine. The finding showed that each succeeding grade level achieved significant high mean score than did female ninth grade students, and the grade level and chronological age respectively were the most important factors in determining the level of concept attainment while IQ was the least important factor.

Overstreet (1970) studied processes deemed necessary to external hypothesis testing theories of simple concept attainment to more complex concept problems. It was concluded that a face with an error which informs his current hypothesis may be able to compare that hypothesis with the currently available stimulus and its feedback to derive information which allow him to temporarily redirect the pool of dimension pairs from which he will sample.

Kyle (1971) determined whether competitive and co-operative conditions have a differential effect on the amount of students' participation and learnings examined whether students reach more positively to one or the other of the conditions and investigated possible relationship between achievement and other dimensions of the study. He found that students learnt no less in the co-operative condition and preferred the co-operative condition. Participation did not appear to be a factor in the level of understanding and did not seem to be affected by either conditions. Level of achievement anxiety seemed to affect concept understanding and condition preference but the relationship was not clear.

Schaeffer (1971) determined if child in fourth grade were able to acquire con-
cept in social studies as effectively by reading as by a sensory activity approach or if a third factor. For example the ability to attend influenced achievement more in one mode than in the other. The finding showed that there were no statistical difference between reading and non-reading approach. However, positive trends were shown for the non-reading approach.

Seldon (1971) made the development of support for generic strategy type differentiation and an empirical study of concept attainment behaviour. It was concluded that the effects of mode of presentation was significant while the effects of organisation of material and complexity of informational field were not found to be significant.

Cason, Caralyn, Leonie, Hulda Huebner (1972) studied a theory of hypothesis generation in concept learning. An information processing approach, they developed and tested an information processing model of concept learning incorporating a hypothesis generation mechanism and concluded that the violation of anyone of these assumptions resulted in the model learning more slowly.

Lawrason (1972) examined the effect on acquisition and transfer of systematic variation in direction of learner behaviour as defined by the sequence of instructional event. He found that there were significant difference between five treatment groups receiving both concept definition and practice and is the control group there was no significant difference, however, the treatment group given practice above the control group.

Wager (1972) investigated the effect of different sequencing strategies on concept attainment. The findings showed that the three programmed instructional treatment had similar effects on the post test performance of the students in term of effectiveness.

David (1973) studied the effects of presenting new concept embedded 230 words prose passages. It was concluded that case of learning concepts from prose material involves complex combination of factors.
Mills (1973) studied the effect of a proposed model for motivation on the concept attainment of selected high school and college students. It was found:

(i) for the high school population, the instructional use of the proposed model for motivation was effective in increasing concept attainment;
(ii) for the undergraduate college population, the instructional use of the proposed model for motivation made no difference in concept attainment.
(iii) for the graduate college population the proposed model for motivation had a positive effect on the concept attainment of the students.

Trundnak (1974) investigated the relative effectiveness of four canonical teaching procedure for attainment and generalization of mathematical concepts. It was found that there were no significant differences in the treatment groups for concept attainment. However, significant differences were found with respect to generalization, but for only one concept.

Simpson (1975) made the objective of his study to what extent can variable identifying in studying concept attainment of social studies concept? He found that there was a higher scores for subjects who had two levels of critical properties identified. This was found to have statistically significant difference and the scores were found to have statistically significant difference in support of the hypotheses.

Marliove (1976) investigated the effect on concept attainment of training for hypothesizing and evaluating defining attributes. The findings of the study did not show the training for hypothesizing and evaluating to be sufficient for formal level concept attainment among subjects, able in classifying examples and non examples and to discriminate and name attributes.

Henkin, Paul Henery (1977) conducted a study on concept attainment and read-
ing achievements in normal disadvantaged and high rank first grade children and concluded that significant differences were found between normal and disadvantaged and high risk children in that latter two groups are different in concept attainment and reading achievement.

**Bordelon (1978)** assessed relationship among concept attainment reading comprehension and listing comprehensions. The finding showed that no significant relationship were found between reading comprehension and concept attainment; no significant relationship were found between listening comprehension and concept attainment. A significant relationship was found between reading comprehension and listening comprehension.

**Stallen (1978)** assessed the effects of methods of organization of individualised learning materials using two types of pre instructional strategies with high and low readers. The finding showed that the basis of the main effects for methods of instruction and reading level, there was no significant difference between mean gain score of the three groups.

**Lowe, Albert, James (1980)** investigated the effect of instruction and practice on concept identification and found that the principle instructions in addition to practice yielded significantly better performance than with only repeated practice and no principle instruction.

**Shineman (1980)** investigated the effect on the information processing behaviour of students teachers having similar or different conceptual interaction of student teachers conceptual on the students teacher's initial and final information processing behaviour. Theoretically predictable by conceptual level theory highly significant differences were found between high and low conceptual student teachers on information processing. Significant difference were found between initial and final information processing behaviour.
Cook, Willie, Clance (1981) investigated to study the coeffect of negative and positive instance in teaching mathematical concepts to Freshman. They observed the difference which appeared among students taught only with positive instance compared with students receiving both positive and negative instance did significantly better than total numbers of instances received in both the groups was the same.

Musa, Mussa, Elkaya, Ettayab (1981) - In their research on "the effect of pictorial representation of concept attainment" and found that there was a significant effect for abstract picture treatment, but it did not effect concept attainment. They have also examined that effect of cognitive style on concept learning and concluded that cognitive style did not show significant effect on concept attainment. They also observed that there was a positive and relatively higher correlation between the concept attainment and abstract picture on one hand and negative or relatively lower correlation between realistic picture treatment and concept attainment on the other.

Siakon Peter and Geogarv (1981) conducted a research on "An evaluation of preservice concept training strategy". They studied the kinds of concept training strategies that are most successfully used by preservice teachers in secondary education can be taught to utilise a generalised concept teaching strategies. However, specific strategies such as concept attainment and concept relationship may have no direct effect in helping preservice teachers to teach concept in these secondary classrooms.

Lee (1983) investigated the interactive effects of the personnel traits of conceptual development and the different presentation form of concept attainment. It was found that there was a statistically significant difference between instruction based on the definition and examples and based on the examples only.

Passi B.K., Singh L.C., Sansanwal D.N. (1985) investigated the effectiveness of
strategy of training in models of teaching in terms of understanding reaction, willingness of teacher educators. The results regarding concept attainment model were that training in concept attainment model in the form of lecture, demonstration, discussion and peer practice feedback did enhance the understanding of teacher educators theoretical aspect of concept attainment model. Further they found that the training in concept attainment model did bring significant change in teacher educator's reaction towards concept attainment model. They also reported that the teacher educators were willing to implement models of teaching in teacher education programmes of the support system was available. They concluded that the training strategy comprising of theoretical discussion, demonstration and peer practice feedback in quardo was found effective in term of developing understanding favourable reaction and willingness to implement models of teaching training programmes.

Kaur Ravinder (1986) conducted a study on effectiveness of training in concept attainment model of preservice secondary school teachers and reported that training in concept attainment model in the form of lecture demonstration, discussion and peer practice feedback did enhance the understanding of preservice teachers theoretical aspects of concept attainment model.

Medonald (1986) investigated the relationship between locus of control and concept attainment strategy. He found that there was statistically significant difference between locus of control, strategy utilization and number of trials to solution. There was no statistical support or a significant interaction between locus of control and utilised strategy on the number of trials solutions.
Oeballos (1986) made the objective of his study to know the effects of concept teaching models on cognitive thinking ability. He found that there was no significant differences between or with in the groups. Similar results were obtained on the other two measurement instruments for the age group under study, inductive and deductive approaches are equally effective in promoting concept formation/concept attainment and in fastening the meta cognitive strategies that are crucial to higher order thinking.

Ponick (1986) investigated instructional design that facilitates concept learning and made focus on manipulating visual cognitive processes affecting concept attainment by the learner. It was found that there was no significant difference among the treatment group.

Roy, P (1986) conducted a study on effectiveness of strategies of training in concept attainment model in pre services teacher trainees. She investigated the relative efficacy of variation in demonstrating along with peer practice feedback in training strategy adopted for training in concept attainment model. She concluded that there was no significant difference in mean gain scores of quadros and pairs in the two practice phases peer practice feedback and coaching.

Schiever, Shirley Whiting (1986) studied, "The effect of two teaching learning models on the higher cognitive processes of students in classes for the Gifted" and concluded that process models offer a powerful method of teaching the higher cognitive processes to gifted students but that such models must be used correctly and frequently.

Dutt, Sunil (1987) conducted an experimental study to see the effects of Bruner’s strategies of problem solving ability of high school science students in relation to intelligence, cognitive style and anxiety level and observed 'Focussing strategy as superior one compared to scanning strategy of problem solving.'

Sushma (1987) studied the effectiveness of concept attainment and Biological
Science Inquiry models for teaching Biology Science to VIII class students to study the effects of concept attainment model based teaching on pupil achievement to study the effects of biological science inquiry model based teaching on pupils achievement and concluded that the Biological Science Inquiry model was found more effective than conventional teaching and concept attainment model was found more effective than biological science inquiry model and no significant difference was found between the gain scores of attitude with Biological Science Inquiry model based teaching and conventional teaching.

Passi, B.K. Singh L. C. Sanswal D.N (1989) conducted an experimental study on effectiveness of strategy of training in Models of teaching and concluded that information processing models emphasize that theoretical discussion, perceptual mode and peer practice in quardo could produce a high level of understanding.

Goel Madhvi (1990) studied that the effect of teaching through concept attainment model on acquisition of language concepts in relation to learners personality and concluded that both the models ie concept attainment model and conventional model of teaching were found to be equally effective in terms of achievement in Hindi language concepts disregarded the level of personality types.

Chopra Seema (1994) studied the effect of teaching through concept attainment model on acquisition of concept in English language and concluded that both the models namely concept attainment model and conventional model of teaching were found to be equally effective in terms of achievement in English language concepts.
Reviews on Inductive Thinking Models:  

Passi, B.K., Singh, L.C and Sansanwal D.N. (1986) studied the adopting training strategy and studying effectiveness of different variation in components of training strategy for CAM/ITM in terms of understanding competence, reactions and pupil liking and found that mean reaction scores of E1, E2 and E3 groups did not differ significantly but the student teachers of E1, E2 and E3 group had variable reactions toward CAM.

Student teachers of both E1 and E2 groups taught through ITM with equal competency. Mean scores of reaction toward ITM of student teachers (as practising teachers) of E1 group did not differ significantly from that of E2 group. Student teachers of E1 and E2 group had favourable reactions. Mean scores of both E1 and E2 groups indicated that they had unfavourable willingness to implement the model.

Dutt Sunil (1989) conducted an experimental study to know the effectiveness of inductive strategies of teaching mathematics on achievement and observed that inductive strategy of teaching was superior than deductive strategy of teaching.

Chaudhary K. (1990) did an exploratory study to find out the impact of teacher personality on competency in Advance Organizer Model and Inductive Thinking Model. It was found that none of the personality traits of the teacher as measured by 16PF tests had any differentiating effect on the competency of inductive thinking model and Advance Organizer Model.

Kochhar S. Rajiv (1993) studied the effectiveness of Hilda Taba’s Inductive thinking model and Bruner’s Concept Attainment model of teaching in learning of Science Concepts and found that both strategies of teaching were found to be equally effective so far as achievement for the acquisition of science concepts were concerned. He further concluded that sex did not account for differential achievement and the variables such as models of teaching and sex did not interact significantly to produce differential achieve-
Review on Advance Organizer Model.

Allen (1969) investigated the effects on the learning and retention of written social studies material of the use of Advance Organizers with memory level or higher order questions and concluded that the effects of the Advance Organizer was not apparent on the first test but on the second test they enhanced the effects of treatment question for average and below average students and resulted in general rather than question specific facilitation of learning for above average students.

Brokev (1969) examined the effects of varying type of introductory information (advance organizer or historical introduction) on the acquisition and retention of knowledge about differentiated geological phenomena found in the field environment. The finding showed that subject receiving advance organizer information did not show significantly greater acquisition and retention than subjects receiving on historical introduction prior to field experience.

Weisberg (1969) examined the use of visual Advance Organizers for learning Earth Science concepts and concluded that there was a significant difference between map as graph organizers and verbal advance organizer.

Steinbink (1970) determined whether or not advance organizers facilitate increased cognitive achievement among disadvantaged black elementary students. It concluded that the difference among the treatment classes, who were taught by different teachers were not significant. The interaction of teacher by treatment was not significant.

Munford (1971) tested the effectiveness of advance organizer in facilitating learning and retention. He concluded that there were no significant difference among the groups in the amount of initial learning or retention.

Lucas (1972) studied the effects of three types of advance organizers upon the learning of a biological concepts. The finding showed that the use of three types of ad-
vance organizers did not significantly affect the learning of a biological concept in seventh
grade Science and that no interactive effect of IQ 'abstract reasoning' and sex were found.

Johnes (1974) investigated the comparative effects level of specific advance orga
nizers on the achievement of students of differing ability levels and found that advance
organizer could be prepared that are selectively beneficial only for subjects of a particular
levels of demonstrated scholistic ability. Advance Organizers prepared for this experi
ment provided significant facilities only in terms of short term retention.

Saretsky (1975) investigated the effect of the advance organizers model on learn
ing with learners at different reading ability levels for topically different prose passages. It
was concluded that there was no significant difference for use or non use of advance
organizers. Main effects for reading ability level and for different prose passages were
found significant. No interaction were significant.

Tavares, Alberto Tareno Valento Maria odete (1976) conducted a study of
Ausubel Advance Organiser Paradigm in an Inquiry Physical science course and con
cluded that the course independent of the use of advance Organizers did not increase the
performance of the students in those outcomes that are evaluated through the instru
ments used.

Joseph (1977) developed lesson for elementary school children based upon
Ausubel's Advance Organizers model. He tested its use for understanding of the casual
and logical questioning and reported that the experimental group using the model gained
significantly high than the control group not using the model.

Salmon (1977) evaluated the utility of the Advance Organizer pre-instructional
strategy using an oral model of presentation. It was concluded that oral advance orga
nizer or learning passages in conjunction with either written material or oral learning pas
sages provide no differentiating in learning or retention with verbally sophisticated subjects.

Oppong (1978) investigated the facilitative effects on achievements or organizer learnt to mastery using geography materials at the ninth grade level. He concluded that the use of advance organizer before each test chapter showed significant superiority in achievement when compared with the non organizer group using test material only.

Leo, H.T. West and Natalie C Kellet (1981) studied meaningful learning of skill was enhanced with the addition of Advance Organizer and the effect was removed if prior teaching in relevant background knowledge has concluded. Further that Ausubel’s theory can be applied to the meaningful learning of intellectual skills.

Moore (1981) conducted a study on the effects of an advance organizer on students differing in prerequisite skills and knowledge. The only significant result was for level effects. The result of this research did not support to Ausubel’s theory.

Tamthai (1982) determined the facilitating effects of a pictorial diagramatic advance organizer on science learning achievement of eighth grade. It was found that the advance organizer did have facilitating effect on female students who were field independent while it inhibited the science learning of field dependent female students.

Chitrive U.G, (1983) conducted a study on evaluating differential effectiveness of Ausubel and Bruner strategies for acquisition of concepts in Mathematics. He concluded that Ausubel’s strategy was superior to traditional strategy for teaching mathematical concepts to eleventh grade students so far as knowledge transfer and heuristic transfer of concepts were concerned. Bruner’s strategy was superior to traditional strategy for teaching mathematical concepts to eleventh grade students. So far as knowledge, heuristic transfer, short term retention and long term retention of concepts were concerned.
Mahaian (1983) made the objective of his study to see whether the effect of Ausubellian Advance Organizer on the learning of formal operational students was any different for their effect on concrete operational students. It was found that there was a significant interaction between the cognitive level and the absence or presence of organizers, at least as far as the immediate post test was concerned. For the two delayed post test there was no significant interaction as far as the composite scores or scores on the recall portion of the test were concerned.

Noel Kant L (1983) made study to investigate the influence of advance organizers in a systematically designed lesson to teach rule using behavior on transfer of rule learning to problem solving situations. The instruction was systematically designed to teach rule using behavior to spell words with cie and cei letter sequences. The conclusions from the study indicate that while students benefit from systematically designed instructions do not necessarily enhance learning transfer.

Dennis (1984) investigated the effectiveness of advance organizers and repetition on achievement in a high school biology class. The findings showed that there was no significant interaction between treatment on the two dependent variables. However there was a significant gains in achievements by students in all groups from pre test to post test.

Livington (1984) investigated the effects of advance organizer and direct instruction passages for high and low ability eight grade students in the learning and retention of meaningful verbal material. The finding showed that there was no statistical difference between the treatment means. High ability subjects achieved significantly higher scores than low ability students in this group on all three occasions.
Hanclosky (1985) made a comparison of Task Analysis, Advance Organizer and Concept Elaboration methods in teaching concepts and principles. He found that the task analysis group performed significantly higher than the advance organizer and concept elaboration groups in both concept and principle learning.

Panda (1986) conducted a comparative study of the effect of Advance Organizer and set induction on learning and found that the difference between the mean achievement of pupils studying through Advance Organizers and set induction and traditional method are significant.

Pandey S.N. (1986) studied the effectiveness of advance organizer model and inquiry training model for teaching social studies to class VIII students to study the pupil reaction toward the advance organizer model and inquiry training model and conventional teaching in terms of pupil's attitude towards social studies and also found that pupils reacted favourably towards inquiry training model and advance organizer model.

Rocheiser Benneth, Noreen Carol (1986) conducted a study on "Four models of teaching: A meta analysis of student outcomes" and concluded that use of any of the four models of teaching namely Advance Organizer Model, Memory Model, Synectics and Cooperative learning/group investigation, is efficacious on a wide variety of outcomes.

Samiriri (1987) studied the effectiveness of instructional material with advance organizer model in terms of achievement of students. The study revealed advance organizer model facilitated achievements among students.

Sood Kamla (1988) studied the comparison of Advance Organizer model and reception strategies for acquisition of language concepts in relationship to cognitive style intelligence and creativity and found concept attainment strategy as more effective mod-
Preddy, Evelyn J.O. (1989) conducted a study by comparing the effects of two types of Advance Organizers on passage comprehension and concluded that the discussion organizer alone or with a prose organizer facilitated better passage comprehension.

Swrup, S. Buddisagar and Rajoria R (1990) investigated the influence of study habits and instructional material 'with' and 'without' Advance Organizer on achievement of B Ed students and concluded that study habits on the whole did not have any significant effect on the achievement of the two groups studying through instructional material 'with' and 'without' Advance Organizer. There was significant interactional effect between treatment and concentration and treatment and support on achievement of students.

Sandhu, Kamalieet (1992) conducted a study on the effectiveness of advance organizer model for acquisition of language concepts in relation to cognitive style and concluded that both strategies of teaching were found equally effective so far as achievement for the acquisition of concepts were concerned. The group having field independent cognitive style scored higher mean than field dependent group in achievement test. Cognitive style acted as a redundant factor towards retention of scores.

Studies on Cognitive Style

Bachman (1979) studied the relationship between cognitive style and concept attainment strategy. He concluded that verbal ability relevance/saliency and task complexity are important mediators in the relationship between FI and concept attainment efficiency and success. The measures of concept attainment strategy was found to be unrelated to FI differences.

Budhdev, Parvina V (1990) studied the effect of cognitive variables on achievement in mathematics of secondary school students and stated that from the beginning of formal education great emphasis is placed on academic achievement. Variable which
affect the academic achievement can be identified as cognitive and noncognitive. Variables such as attitude towards mathematics, intelligence, mathematical attitude and achievement in mathematics were taken and was found that students of favourable attitude group had higher achievement than the students of unfavourable attitude group. As the intelligence of students increases the achievement in mathematics also increases.

Lata Manju (1990) in her investigation studied the relationship of cognitive style with scholastic achievement and intelligence and found that intelligence play a significant role in every sphere of life including learning. Scholastic success or achievement is also an important part of total personality development.

Raju, Santanna (1990) conducted an investigation of the overlap of the cognitive and affective outcomes in secondary school biology through the use of shared variables. He has written that the classification of human behaviour into cognitive affective and psychomotor outcomes by Bloom and his associates (1956, 1964, 1972) provided a very useful model for classroom operations. He concluded that there is considerable interdependence among the outcomes in the cognitive and affective domains. As such they cannot be treated as independent. There is considerable and significant dependence among the different cognitive and affective outcomes used in the study.

Gautam Gargi (1992) conducted an investigation on the effect of inquiry training model on achievement of adolescents studying economics in relation to their cognitive style and found that inquiry training model of teaching was more effective than traditional model of teaching in terms of achievement in economics and the interaction between teaching models and different levels of cognitive style was found to be insignificant.
**Studies on Self Concept**

Brym Mawr (1988) conducted an investigation in the difference in self concept as a function of academic achievement gender grade of elementary and middle school achiever and under achiever. He found that gifted children as a group revealed a profile similar to the norm group with the exception of scholastic competence Self Concept which was above the norm group. Within group difference lower scores in most domains of self concept were found in middle school campared with elementary school students although interaction with achievement level was not found in the same way as with scholastic competence. It was also found the girls consider themselves higher than the boys while boys view themselves higher than girls in atheletic and physical self concept.

Nappier Cherry Mcrwy (1989) compared the self concept of Black elementary school students attending conventional and alternative programme in public, private and parachial school and found that significant difference in self concept existed in school affiliated subtest scales of SOS between students studying in two schools. Another significant result indicated that male scores significantly higher than female in self security subtest scale students in grade II and III scored significantly higher than student in grade I.

Kumar, Devinder (1991) conducted an investigation of academic achievement of adolescents in relation to their self concept and socio economic status and concluded that there was no significant relationship between academic achievement and self concept and further he found that there was no significant difference between academic achievement of adolescent belonging to high and low self concept.

**Studies Related with the present study:**

The research related with present study as Siakon, Peter and Geogary (1981) found that strategies like concept attainment and concept relationship have no direct effect in helping preservice teacher to teach concept in their secondary class rooms. **Sushma**
(1987) studied the effectiveness of concept attainment and biological science inquiry model for teaching biology to class VIII and found that concept attainment model is better than biological science inquiry model or conventional model. Goel Madhvi (1990) found that concept attainment model and conventional method were equally good for acquisition of concept in Hindi language. Chopra, Seema (1994) studied that both models ie concept attainment model and conventional models were equally good in learning of concept in English language. Dutt Sunil (1989) found that inductive strategy as superior strategy as compared to deductive strategy of teaching in learning of concept in Mathematics. Kochhar S. Rajiv (1990) studied the effectiveness of Hilda Taba's inductive thinking model and Bruner's concept attainment model of teaching in learning of concept in science and found that both strategies were equally good in learning of concepts in science. Lucas (1972) studied the effects of three types of advance organizers upon the learning of biological concepts and found all these were insignificant in learning of concept in biology. Tamathi (1982) determined the facilitating effects of a pictorial diagramatic advance organizer on learning of concept in science and found that advance organizer did have a facilitating effect on female students who were field independent. Chitrive UG (1983) found that both Ausubel and Bruner concept were superior than traditional method in learning of concept in mathematics. Bruner strategy was superior in short term and long term retentioin of concept. Samriti (1987) studied that advance organizer model facilitated achievement among students. Sood Kamla (1989) studied the comparison of Advance Organizer model and Bruner's reception strategies for acquisition of concept in language and found concept attainment strategies was more effective model of teaching Hindi concept. Sandhu Kamaljeet (1992) found that advance organizer model and traditional model were equally effective in learning of concepts in language. The group having field independent cognitive style scored higher mean that field dependent group in achievement.
Bachman (1979) studied the relationship between cognitive style and concept attainment strategy and found that concept attainment was found to be unrelated to FI differences. Lata Manju (1990) studied that cognitive style and intelligence play an important role in every sphere of life including learning. Gautam Gargi (1992) found that interaction between different teaching model and cognitive style was found to be insignificant in learning of concept in Economics.

In the light of above, there is an immediate and urgent need for a number of research studies which may provide some data on the comparison of different models of teaching for teaching science to high school students. It is all the more desireable, since no such in-depth study has been conducted and ones completed abroad are scanty and none has been done with the cognitive style, achievement motivation and self concept.